Drivers and Barriers in Sustainable Manufacturing Implementation in Malaysian Manufacturing Firms

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***Abstract*— Sustainable manufacturing practices seek to optimize production efficiency while minimizing environmental impact. Nowadays, the implementation of sustainable manufacturing practices in companies has increased. By implementing sustainable manufacturing practices, firms can gain better access to international markets; enhance business profile, consumer perceptions and corporate reputation and increase the manufacturing capacity. However, the implementation of sustainable manufacturing practices is posed to many drivers and barriers in light of the benefits manufacturing firms stand to gain from this initiative. This paper aims to investigate the drivers and barriers of sustainable manufacturing implementation in Malaysia. In this study, data were collected by using a self-administered questionnaires. The result shows that the increment in the overall cost of implementation is regarded as the main barrier to implementing sustainable manufacturing practices while environmental regulation and top management commitment are regarded as the main drivers. This research has been able to highlight the important barriers and drivers of implementing sustainable manufacturing practices through which industries can improve the manufacturing practices to offset the negativity on the environment.**

Keywords—sustainable manufacturing; implementation; environmental regulation; Malaysia

I. INTRODUCTION

Nowadays, sustainable manufacturing use environmentally friendly practices to reduce their impact on the environment, in fact by using this, world class manufacturing also can improve the profitability of their business. According to Brundtland report, sustainability is defined as a growth that meets the needs of the present without compromising the capability of the upcoming generation to meet their own needs [1]. Sustainability has been applied in many fields such as manufacturing, engineering and design. Manufactures are more concerned about sustainability issues, for example, in recognition of the relationship between the natural environment and manufacturing operations, which plays an important role in decision making among industrial societies [2]. According to Szeckely & Knirsch [3], sustainability is the creation of balance between the economic, social and environmental aims of organizations. This is indicated in business as expanding economic growth, shareholder value, corporate reputation and the quality firms' outputs.

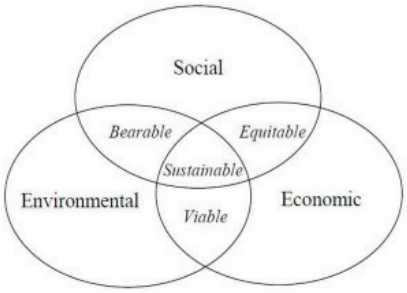

FIGURE 1 TRIPLE BOTTOM LINE PRINCIPLE OF SUSTAINABILITY

No single definition has been posited for sustainable manufacturing because it is a journey that does not have an end point. According to US Department of Commerce [4], sustainable manufacturing is defined as the creation of manufactured products that apply processes which are non-polluting, natural resources and converse energy and economically- sound process that minimizes the negative impacts on the environment and it also enhances safety for employee, communities, consumers and products. On the other hand, technical version of this sustainable manufacturing definition's is known as a system that approach for the creation and distribution of innovative products and services which can minimize the resources of inputs, eliminates toxic substances and produces zero waste that in effect reduces green house gases.

National Strategy for Ecologically Sustainable Development defined sustainable manufacturing as conversing, using and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future can be increased [5]. According to The Queensland Government sustainable manufacturers were defined as those who improve their company's profitability by using world-class manufacturing and environmentally friendly practices.

Many studies have been conducted on sustainable manufacturing practices in the developed countries but very few studies have investigated the drivers and barriers of sustainable manufacturing practices within the context of developing countries. As such, the sustenance of the manufacturing industries solely relies on the identification of its drivers and barriers. According to Ijomah [6], sustainable manufacturing has become a critical issue for

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industries and in order to survive in today's competitive business environment, adopting sustainable manufacturing practices has become a necessity. Therefore, this study seeks to investigate the drivers and barriers of sustainable manufacturing implementation in Malaysia representing the developing countries in Asia Pacific region. The findings could identify the factors that motivate the implementation of sustainable manufacturing in developing countries, and also determine factors that slowed down the sustainable manufacturing practices.

II. LITERATURE REVIEW

The manufacturing sector is one of the most important sectors that hugely contribute to the GDP of Malaysia. The contribution has been noticeable, especially in term of export products and employment creation opportunities [7]. The drive for sustainable practices in the manufacturing sector has been on an increasing momentum since the beginning of the new millennium [1][2]. Manufacturing industries have been making an effort to achieve sustainable manufacturing practices by shifting their manufacturing operation from an end of pipe solutions to more sustainable manufacturing practices such as product life cycles, integrated environmental strategies and environmental management systems [8]. The effort has also been made by manufacturing firms to create closed-loops, circular production systems and adoption of new business models towards achieving sustainable manufacturing practices [8][9].

Manufacturing companies have been forced to give considerations to sustainable manufacturing practices due to the alarming social and economic factors [1] especially among the countries in the Asia-pacific regions and the USA [8]. Many previous studies in the Europe have concurred on the need for nation to uphold sustainable manufacturing practices [1]. Within the context of Malaysia, some studies [8][10][11] have asserted the need for Malaysian manufacturing companies to become sustainable. Efforts have also been taken by many automotive industries in Malaysia to inculcate environmental friendliness into their manufacturing practices.

Researchers concerned with ecological issues have asserted that many organizations respond to environmental issues based on their drives in implementing the initiatives [12]. Various drivers have been highlighted as being responsible for the implementation of sustainable manufacturing practices but these drivers may be diverse depending on the political, economic and social region within which firms operate. As such, it is pertinent to investigate the factors that drive the implementation of sustainable manufacturing practices in Malaysia. Though, many studies have been conducted on the sub-domains of sustainable manufacturing practices, however, only few studies have investigated the factors that motivate and de-motivate the implementation of sustainable manufacturing practices, especially in Malaysia.

III. RESEARCH METHOD

Prior to the collection of the main data used in this study, the researcher has conducted a preliminary study aimed at identifying the drivers and barriers of sustainable manufacturing practices in the respondents' companies. The preliminary study involved an interview section of three (3) manufacturing practitioners. This was conducted to enable the researcher identified the possible drivers and barriers. Upon the completion of the preliminary study, a mail survey questionnaire technique was used to collect data from the selected respondents of this study, which are the operation managers, manufacturing managers and the environmental, safety and health managers of manufacturing firms in Malaysia. The list of the respondent was obtained from the directory of Federation of Malaysian Manufacturers [13]. These respondents are thought of being aware and well versed with the issues of sustainable manufacturing practices in their firms. Respondents were asked to identify by choosing the main five drivers and barriers of sustainable manufacturing implementation in their firms. From this, fifty six (56) usable questionnaires were collected and analyzed by using SPSS version 20. The section below presents the findings of the study.

IV. RESULT AND DISCUSSION

A. General Background of Respondents and Companies

The first aspect to be investigated was the general background of the respondents and the companies involved. Table 1 shows the general background of the respondents such as job position, and years of employment in the company. The respondents of this study were mostly environmental/health and safety managers (39%). Majority of the respondents have occupied their current position between 1 to 5years (41.1%) and most of them have worked in the same company for more than one year. The indication of this is that the respondents are well represented and have vast knowledge of sustainable manufacturing practices of their companies.

TABLE 1 GENERAL BACKGROUND OF THE RESPONDENTS (n=56)

		n	%
1.	**Position**		
	Operation	7	12.5
	Production/manufacturing	9	16.1
	Environmental/ Health and safety	22	39.3
	Others	18	32.1
2	**Years of employment (in current position)**		
	Less than 1 year	12	21.4
	1-5 years	23	41.1
	6-10 years	5	8.9
	More than 10 years	16	28.6
3	**Years of employment (in current company)**		
	Less than 1 year	9	16.1
	1-5 years	24	42.9
	6-10 years	7	12.5
	More than 10 years	16	28.6

Table 2 shows the general background of the companies involved in the study. The factors investigated were quality type of industry, system certification, company ownership, and company size. The result revealed that the respondents were mostly from large companies (50%) having more than 251 full time-full-time employees and from Electrical and electronic industrial category (30.4%). This is evidence that the Malaysian manufacturing sector is dominated by the electrical and electronic companies. Most of the companies are multinational companies (44.6%) certified with environmental management system - ISO 14001 (48.2%). The indication of this result is that these companies are technological and financially capable of implementing sustainable manufacturing practices.

TABLE 2 GENERAL BACKGROUND OF THE COMPANIES (n=56)

		Frequency	%
1	**Category of industry**		
	Food products and beverages	4	7.1
	Textile, wearing apparel	1	1.8
	Paper and allied products	4	7.1
	Chemical and allied products	2	3.6
	Rubber and plastics	11	19.6
	Basic metallic parts	4	7.1
	Electrical, electronic, computing machinery parts	17	30.4
	Transport equipment	3	5.4
	Others	10	17.9
2	**Certification**		
	ISO 9001	12	21.4
	ISO/TS 16949	2	3.6
	ISO 14001	27	48.2
	Other	15	26.8
3	**Ownership**		
	Stated Owned Enterprise	2	3.6
	Joint Venture	3	5.4
	Private Enterprise	19	33.9
	Multinational Company	25	44.6
	Foreign	7	12.5
4	**Company size (based on number of employees)**		
	Small (51 – 150)	15	26.8
	Medium (151 – 250)	13	23.2
	Large (more than 251)	28	50.0

B. Drivers of Sustainable Manufacturing Practices

TABLE 3 DRIVERS OF SUSTAINABLE MANUFACTURING PRACTICES

Drivers	**n**	**%**
Environmental Regulation	46	82.1
Top management Commitment	44	78.6
Company Image	38	67.9
Economic benefits	33	58.9
Environmental responsibility	31	55.4
Public concern	30	53.6
Long term survival in the market	28	50.0
Perceived benefits	27	48.2
Stakeholder Pressure	25	44.6

The respondents were asked to indicate the possible drivers of sustainable manufacturing practices in their companies. The result as shown in Table 3 below shows that majority of the respondents selected that environmental regulation; top management commitment and company's image are the strongest drivers of sustainable manufacturing practices in their companies.

In this study it is revealed that environmental regulation is the most important factor driving sustainable environmental manufacturing practices in Malaysia, this is consistent with the study by Adebambo et. al [14] and Chen & Shih [15]. Similarly, many studies also agreed with top management commitment and attitudes towards sustainable manufacturing implementation [16][17] as the top management has strong influences in corporate environmentalism. Regarding to company image, Braglia & Petroni [18] and Amrina [11] suggest that Adoption of sustainable manufacturing practices will enhance manufacturing firms to achieve greater organizational efficiency and hence will enhance the green image among firms.

C. Barriers of Sustainable Manufacturing Practices

This study expects that manufacturing companies in Malaysia like other countries still face difficulties in implementing sustainable manufacturing practices. As such, the respondents were asked to indicate the barriers facing their companies in implementing sustainable manufacturing practices. The result as shown in Table 4 indicates increment in overall cost of implementation as the main barrier of sustainable manufacturing practices. This is consistent with the findings of Muller & Rusell [19] who identified cost as the most barrier faced when implementing new concepts. Another high ranked barrier by the respondents is the lack of specific ideas on what to do and when to do it. This has the same ranking with lack of awareness and understanding in companies. The possible reason for the second ranked barrier may be as a result that a sustainable manufacturing practice is relatively a new idea in developing counties.

TABLE 4 BARRIERS OF SUSTAINABLE MANUFACTURING PRACTICES

Barriers	n	%
Increment in overall cost	48	85.7
Lack of awareness and understanding in companies	30	53.6
Lack of specific ideas on what to do and when to do	30	53.6
Lack of demand from consumers and customers	29	51.8
Lack of employees commitment	27	48.2
High cost of training requirement	23	41.1
Lack of management commitment	21	37.5
Lack of government regulation	19	33.9
Lack of demand from suppliers	17	30.4
Lack of demand from the community	17	30.4
Incompatibility between management and manufacturing system	13	23.2
Lack of demand from shareholders and investors	8	14.3

V. CONCLUSION

In this paper, the result of an investigation into sustainable environmental manufacturing practices in Malaysian manufacturing companies was presented. The result established that environmental regulation, top management commitment and company's image are very important in driving the implementation of sustainable manufacturing practices.Increment in overall cost, lack of ideas on what to do and including lack of awareness and understanding in companies are the major factors demotivating the implementation of sustainable manufacturing practices in Malaysia. From this result, it is certain that sustainable manufacturing practices is receiving attention in Malaysia and more attention should therefore be given to the motivating and demotivating factors to enhance the successful implementation of the initiative.

Based on the findings, some recommendations are given to how the issues of sustainable manufacturing implementation can be most effectively implemented in the companies, especially in Malaysia:

i) Regulations and government policy could increase the statutory requirement and the environmental consciousness of the manufacturing companies. According to Paulraj [20], the more stringent an environmental policy within a jurisdiction is, the more the environmental performance of the firm

ii) The role of top management in showing their commitment to the implementation of sustainable manufacturing practices through direct involvement in the environmental issues of the firm. This commitment is shown by appointing senior managers to oversee the environmental issues of the firm [17].

iii) It is suggested that the companies to certified in ISO 14001. According to Sebhatu & Enquist [21], ISO 14001 could act as an active tool for promoting comprehensive organisational changes leading to sustainable development.

Therefore, the future research will concentrate on a framework of how to effectively implement sustainable manufacturing in manufacturing sectors especially in Malaysia, based on the findings obtained.

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